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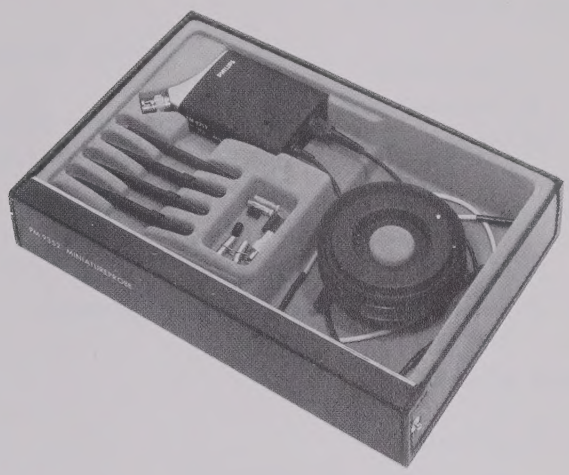

MANUAL

MINIATURE PROBE PM 9352

9499 440 07911

30/171/1/01

CONTENTS

GENERAL INFORMATION 5

I. Introduction 5
II. Technical data 5
III. Accessories 7

DIRECTIONS FOR USE 9

IV. Setting up procedure 9
V. Probe output and compensation adjustments 9

SERVICE INFORMATION 10

VI. Description 10
A. Probe tip and coaxial lead 10
B. Compensating box 10

VII. Explanation of the circuit 10
A. The HF section 11
B. The LF section 11

VIII. Dismantling the probe 11
A. Introduction 11
B. Dismantling the probe tip 11
C. Dismantling the compensating box 12

IX. Tests and adjustments 12
A. Introduction 12
B. Equipment required 13
C. Zero and gain adjustments 13
D. LF and MF adjustments 13
1. Adjusting R22 13
2. Adjusting R3 13
3. Adjusting R15 and R43 16
4. Adjusting C12 18
E. HF adjustments 19
F. Rise time performance check 19
G. Displayed noise performance check 20

X. Parts list 21
A. Mechanical 21
B. Capacitors 22
C. Resistors 22
D. Transistors 23
E. Inductors 23

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LIST OF FIGURES

Fig.		
1	Input impedance and capacitance as a function of frequency	6
2	Dynamic range of the PM 9352	6
3	Dual in-line circuit accessory used with its earth lead	7
4	Wrapped wiring accessory used with its earth lead	7
5	Access to C12 and R27	9
6	Simplified diagram of probe amplifier circuit	10
7	Critical dimension of R1 and C1 assembly	11
8	Amplifier circuit board	12
9	Adjusting R22	14
10	Adjusting R3	14
11	Initial adjustment of R15	16
12	Adjusting R43	17
13	Final adjustment of R15	17
14	Adjusting C12	18
15	Adjusting R14	19
16	Schematic diagram of equipment for displayed noise check	20
17	Mechanical parts	20
18	Probe accessories	21
19	Circuit board assembly	24
20	Circuit diagram of PM 9352	24

GENERAL INFORMATION

I. INTRODUCTION

The Philips miniature probe type PM 9352 is an active device which provides a 10x attenuation of the input signal. The probe circuit has been designed for use with oscilloscopes having bandwidths of up to 150 MHz, an input impedance of 1 MΩ, and a parallel input capacitance of between 14 and 21 pF. The miniature design of the probe tip and its attachements enables easy access to test points which are normally difficult to reach. The probe is particularly suited to the following applications:

- Miniature printed boards
- Wrapped wiring systems (Fig. 4)
- Dual in-line integrated circuit packages (Fig. 3)
- Standard TO packages

The probe may be supplied form a suitable "probe power" socket on the oscilloscope or alternatively from a Philips auxiliary power unit. The power requirements are +24 V, 26 mA and -24 V, 25 mA.

II. TECHNICAL DATA

Attenuation	10x connected to a 1 MΩ input Tolerance after readjustment $\pm$ 1 %
Input resistance	DC 110 kΩ AC 100 kΩ
Input capacitance	6 pF
Input impedance	As shown in Fig. 1
Rise time	$\leq$ 1.6 ns (measured with a maximum voltage of + or - 3 V)
Equivalent bandwidth (probe only)	DC to $\geq$ 220 MHz (-3dB)
Dynamic range	As shown in Fig. 2. The compression at the limits of the dynamic range is 5 % or less
Rounding, overshoot and ringing	Between + and - 2 % or less for the probe alone when used with a 50 MHz high impedance oscilloscope, or + and - 3 % for the probe alone when used with a 150 MHz oscilloscope
DC drift of probe amplifier	$\leq$ 0.5 mV/°C
Tangentially measured noise	< 1 mV
Signal delay time	14 + or - 0.5 ns
Compensation range	14 to 21 pF(input capacitance of oscilloscope)
Maximum overload voltage	$\pm$ 75 V (continuous DC plus peak AC)
Pulses - periodic	$\sqrt{1/\text{duty cycle}}$ x 75 V with a max. of $\pm$ 150 V and a max. pulse duration of 1 sec.
Pulses - non periodic	Pulse duration < 20 ms at + or - 300 V
Probe power requirements	+24 V at approx. 26 mA, and -24 V at approx 25 mA
Temperature range	-10°C to +55°C within specification acc. to IEC 68B
Probe tip and half cable	-10°C to +70°C within specification

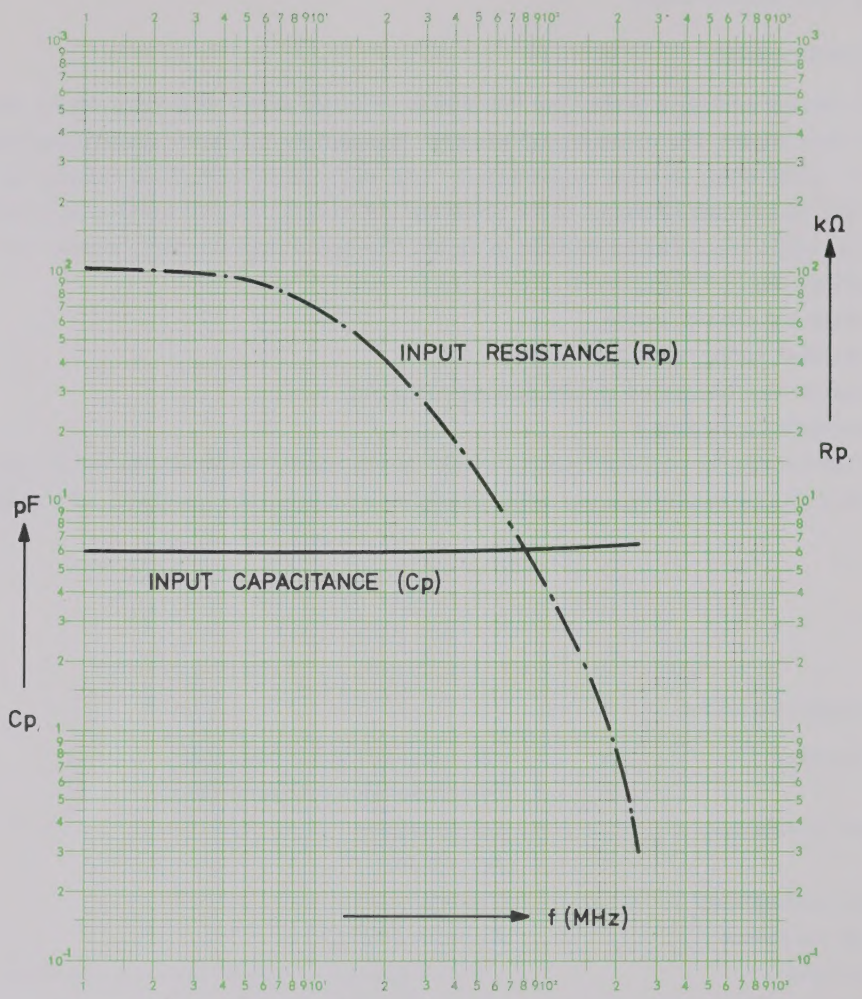

Fig. 1 Input impedance and capacitance as a function of frequency

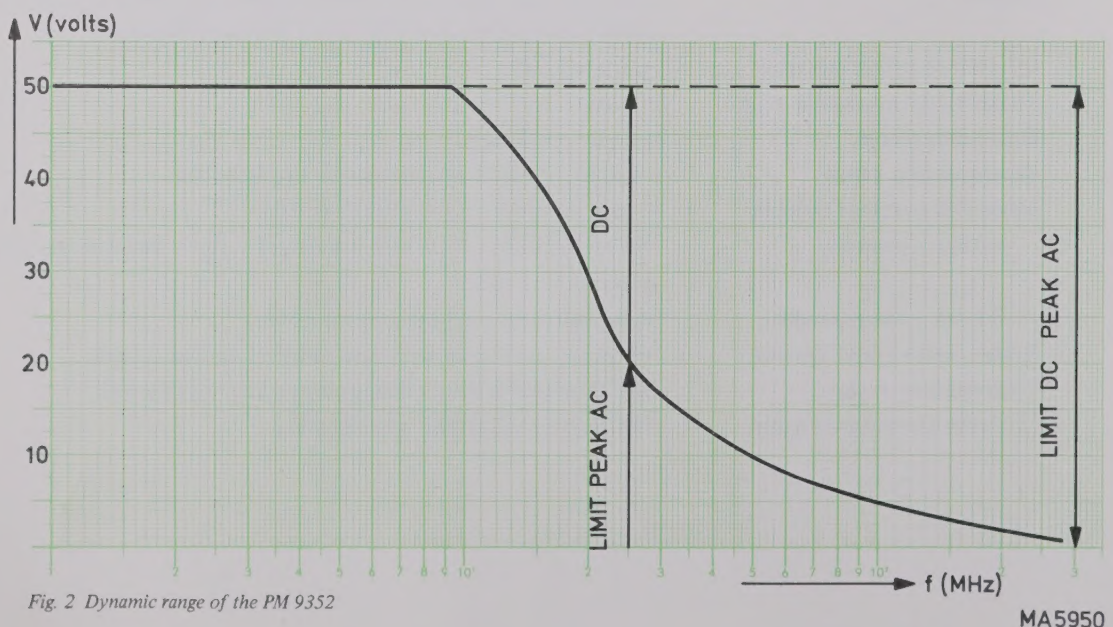

Fig. 2 Dynamic range of the PM 9352

III. ACCESSORIES

The probe tip accessories shown in fig. 18 consist of the following components:

- Probe tip for wrapped wiring systems (10) for pins of up to 1 mm diameter
- Probe tip for dual in-line integrated circuit applications (11). It is recommended that the following method of connection is used in order to avoid inadvertent short-circuits:

  1. Holding the probe at its forward end, push it on to the lead from which the measurement is to be taken
  2. Apply a forward pressure to the rear of the probe so that the lead is gripped firmly by the hook of the probe
  3. To release the probe, carefully pull the front end of the probe

  CAUTION Do not attempt to pull the probe by its rear end, otherwise damage will result

- Test hook (12)
- Insulating tube (13) for the probe tip earthing ring
- Probe tip connectors (14) capable of being soldered into the circuit. These connectors can also be used as protective caps for the probe tip pin
- Probe adaptor (15) for BNC and N-connector
- Earth tip (16) for use when the ordinary earth lead inductance is significant
- Right-angle connector (17) capable of being soldered into the circuit
- Short earth lead (18) for wrapped wiring systems. Suitable for pins of up to 1 mm diameter
- Long earth leads (19) for wrapped wiring systems. Suitable for pins of up to 1 mm diameter
- Earth lead equipped with crocodile clip

Fig. 3 Dual in-line circuit accessory used with its earth lead

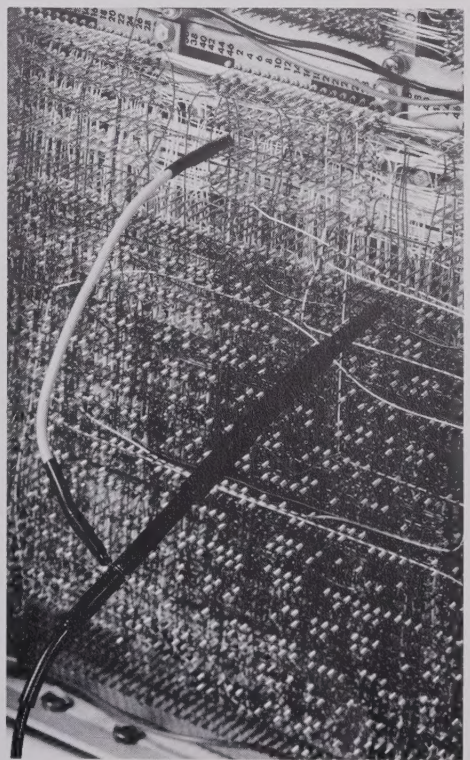

Fig. 4 Wrapped wiring accessory used with its earth lead

DIRECTIONS FOR USE

IV. SETTING UP PROCEDURE

Connect the miniature probe to its oscilloscope as follows:

- Couple the BNC connector of the probe with the input socket of the oscilloscope
- Insert the power supply plug into the "probe power" socket of the oscilloscope (or connect it to the auxiliary power unit)
- Allow the probe amplifier circuit to remain energized for at least 3 minutes so that it may reach operational stability, before the following adjustments are made

V. PROBE OUTPUT AND COMPENSATION ADJUSTMENTS

The following adjustments must be made in order to ensure accurate operation of the probe:

- Insert a small screwdriver into the slot of R27 (accessible through an opening in the compensating box, shown in Fig. 5) and trim the output to within $\pm$ 2 mV of zero output as displayed by the oscilloscope
- Connect the probe tip to a pulse generator using a 50Ω feed through termination and a probe adaptor
- Set the pulse generator to a pulse repetition time of 10 μs and for a display amplitude of 4 divisions. Set the oscilloscope as follows:

a. Vertical	Volts/div	0.05
	Coupling	DC
b. Time base	Time/div	2 μs
	Triggering	AUTO HF (preferably)

- Use a small screwdriver to adjust C12 (also accessible through an opening in the compensation box) in order to compensate for the input capacitance of the oscilloscope. Note that the correct waveform is shown in Fig. 14.

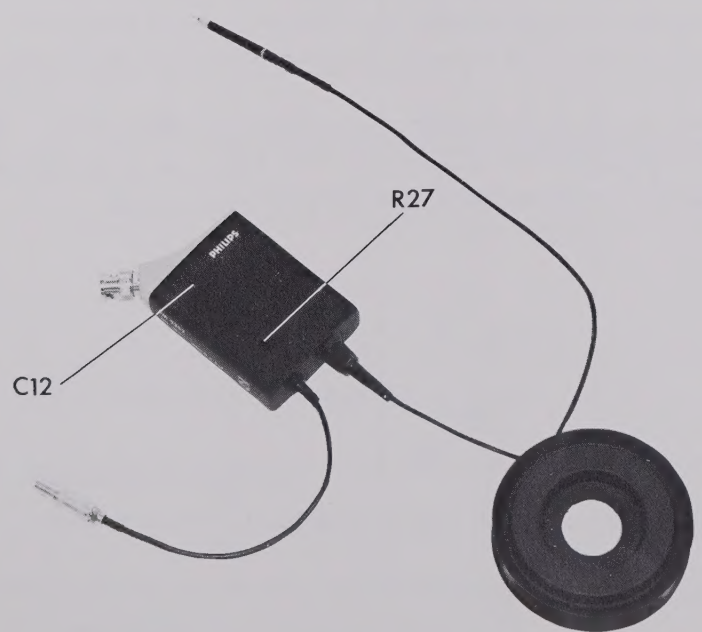

Fig. 5 Access to C12 and R27

SERVICE INFORMATION

VI. DESCRIPTION

A. Probe tip and coaxial lead

The metal body of the probe tip houses a miniature resistor and a chip capacitor which are connected in parallel between the tip and the coaxial lead. The total value of the capacitor combined with stray capacitance is 6 pF and the impedance of the parallel combination is shown in Fig. 1. The coaxial cable which connects the probe tip to the amplifier is formed by 2.5 m of 50 Ω cable, the end of which is terminated so that it presents a resistive load throughout the frequency band. Access to the resistor and capacitor is gained by unscrewing the shell of the probe tip body and removing the protective sleeve.

B. Compensating box

The amplifier circuit board is attached by two screws and spacing washers to a metal bracket which is clamped to the moulded top of the compensating box. The cover is held in position over the circuit board by means of the knurled collar through which the coaxial lead passes. Supplies at +24 V and -24 V are connected to the amplifier via the three core lead and connector plug BU2. The output signal connection to the oscilloscope is made by the BNC plug BU1, which is attached to the moulded top of the compensating box.

VII. EXPLANATION OF THE CIRCUIT

Reference to the simplified diagram and circuit diagram (Figs. 6 and 20) will show that the circuit may be considered as two sections, i.e. the LF and HF sections

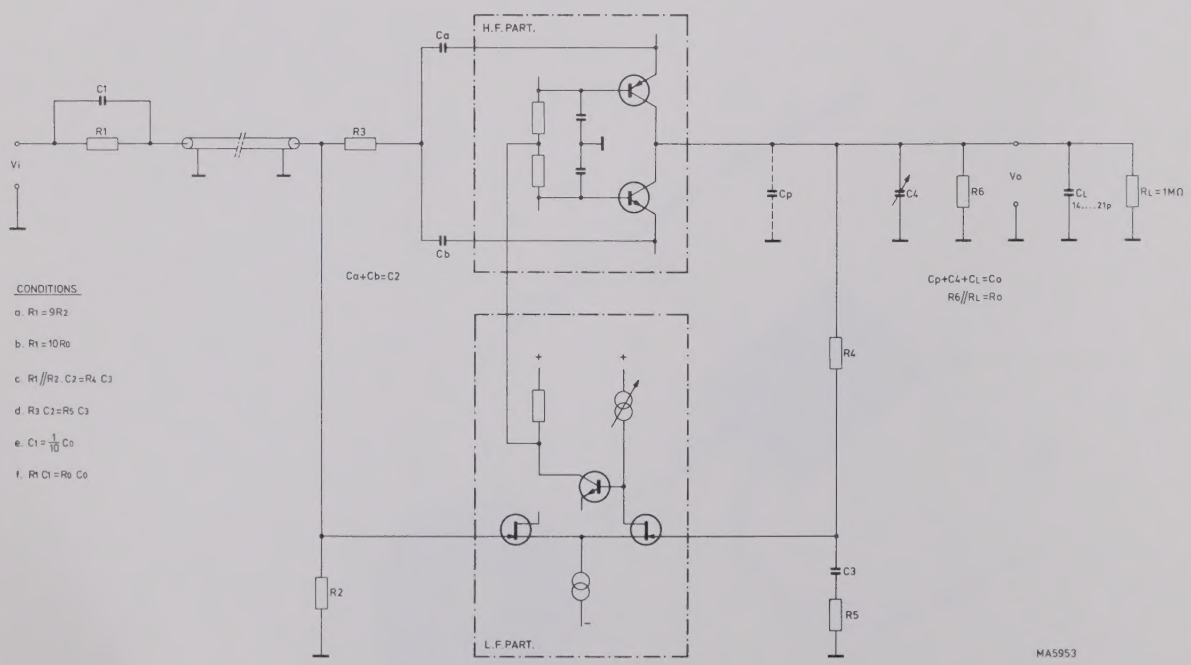

Fig. 6 Simplified diagram of probe amplifier circuit

A. The HF section

The HF section includes the two transistors TS1 and TS2 which are connected as a complementary pair in common base configuration. The bases are biased by the network formed by R4, R6, R7, R8, R9, R11 and the input signal is fed to the emitters via capacitors C4 and C6. The output of the HF stage is connected to the output socket BU1 via potentiometer R14. The total output impedance shown by the stage, including its associated correction networks, transistor impedance, and the effect of the oscilloscope, is 10 kΩ in parallel with 40 pF provided that the probe is compensated. This value of impedance, together with that of the probe input, provides the 10x attenuation as shown in the simplified diagram. Note that the trimmer C12 is connected in parallel with the output so that the probe can be adjusted to suit oscilloscopes having an input capacitance within the range of 14 to 21 pF.

B. The LF section

The LF section, which consists of a pair of matched field effect transistors operating in conjunction with two current source stages, provides the LF-transfer and temperature-stabilisation functions. The field effect transistors form a differential amplifier with a current source circuit (TS8) employed in its common source in order to increase the control range. Amplification is obtained by increasing the drain load using the second current source stage (TS4). This second current source stage incorporates a preset potentiometer R27 which enables the current flow to be adjusted in order to bring the output voltage to zero. Coupling between the LF and HF sections is obtained by TS3.

VIII. DISMANTLING THE PROBE

A. Introduction

This section provides dismantling procedures required for renewal of components during repair operations. A careful note should be made of disconnected leads so that they may be reconnected to their correct terminations during assembly. Extreme care must be taken not to overheat the components whilst soldering, otherwise damage will result. The components R1 and C1 located in the probe tip are particularly subject to damage by overheating. If the R1 and C1 assembly is renewed, ensure that the overall length of 34 ± 0.3 mm is maintained.

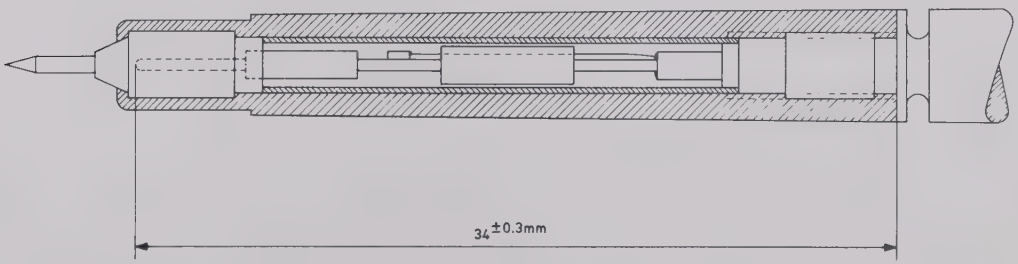

Fig. 7 Critical dimension of R1 and C1 assembly MA5949

B. Dismantling the probe tip

- Unscrew the shell of the probe tip body and remove the polythene sleeve which covers R1 and C1.
- Unsolder the joint between R1 and C1 and the cable, taking care only to apply the smallest amount of heat required to melt the solder

When replacing the R1 and C1 assembly, ensure that the dimension shown in Fig. 7 is maintained within the stated tolerance

C. Dismantling the compensating box

- Unscrew the collar through which the coaxial lead passes
- Carefully slide the cover from the assembly ensuring that the power supply lead passes smoothly through its grommet
- Loosen the supply cable clamp, unsolder the supply connections (red, blue, green and screen), then carefully pull the lead through its grommet
- Unsolder the coaxial probe lead, remove the nut which secures the cable entry gland, and withdraw the gland complete with the probe lead
- Unsolder the BNC connector lead
- Remove the two screws with washers that secure the printed wiring board to the metal bracket
- Unscrew the nut which clamps the metal bracket and top portion of the compensating box to the BNC connector

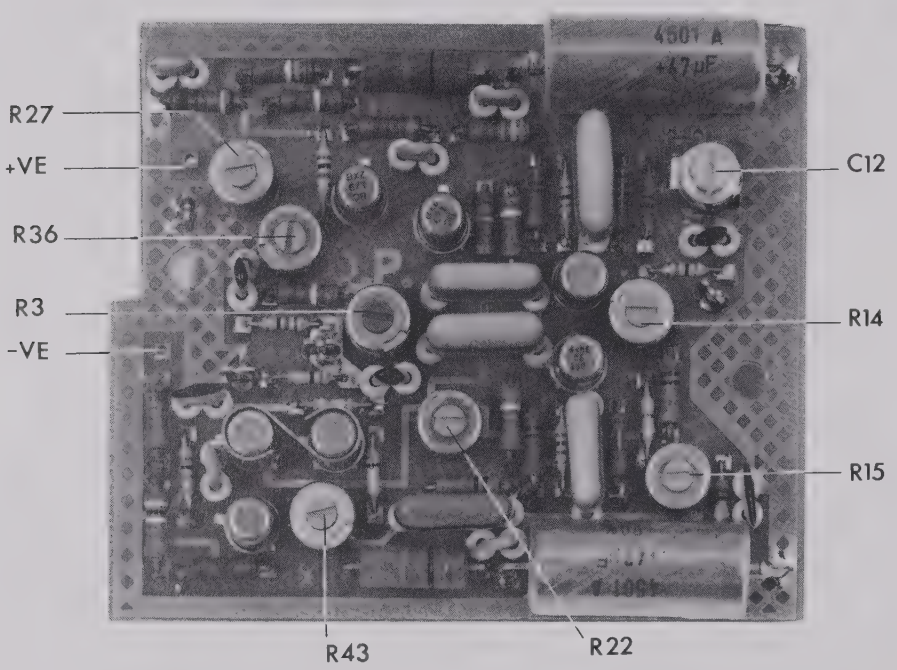

Fig. 8 Amplifier circuit board

IX. TESTS AND ADJUSTMENTS

A. Introduction

This section details the tests and adjustments required to fully set up the miniature probe. The adjustments must be performed in the following order to ensure full accuracy:

- Zero adjustment (R27)
- Gain adjustment (R36)
- LF and MF adjustments (R3, R15, R22, R43 and C12)
- HF adjustment (R17)

Prepare for the adjustment procedure by plugging the miniature probe into the oscilloscope and connecting its supply. Note that the equipment must be energised for three minutes before any adjustment is made.

B. Equipment required

The following items of equipment are required for the test and adjustment procedure:

- Oscilloscope (rise time less than 2.4 ns) Philips type PM 3370, with the plug-in unit type PM 3372.
- Pulse generator PM 5711
- Fast pulse generator, rise time less than 1 ns
- Power supply unit, Philips type PE 4818
- Attenuator unit (100 dB in steps of 10 dB)
- BNC feed through termination, (50 Ω) PM 9585
- Probe adaptor

C. Zero and gain adjustments

- Insert a small screwdriver into the slot of R27 and trim the output to within ± 2 mV of zero output.
- Unscrew the knurled collar through which the probe lead passes and withdraw the cover from the circuit board
- Set the power supply unit type PE 4818 to 5 V and connect the output to the probe tip. An earth lead accessory will prove convenient for this purpose
- Trim R36 in order to obtain an output voltage of 0.5 V ± 1 %
- Disconnect the power unit but leave the compensating box open in readiness for subsequent adjustments

D. LF and MF adjustments

1. Adjusting R22

- Set the pulse generator PM 5711 for a pulse repetition time of 100 ms and for a display amplitude of 4 divisions
- Set the oscilloscope as follows:

a. Vertical	Volts/div	0.05
	Coupling	DC
b. Time base	Time/div	20 ms
	Trigger	Auto, LF,+

- Connect the probe to the pulse generator PM 5711 using the 50 Ω termination and probe adaptor
- Adjust potentiometer R22 for a correct response as shown in Fig. 9
- Disconnect the pulse generator type PM 5711

2. Adjusting R3

- Set the fast pulse generator for a pulse repetition frequency of between 10 kHz and 1 MHz and for a display amplitude of 4 divisions
- Set the oscilloscope as follows:

a. Vertical	Volts/div	0.05
	Coupling	DC
b. Time base	Time/div	0.05 µs
	Trigger	Auto, HF, +

- Connect the probe to the fast pulse generator using the 50 Ω termination and the probe adaptor
- Adjust R3 for a correct response as shown in Fig. 10
- Disconnect the fast pulse generator

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Fig. 9 Adjusting R22

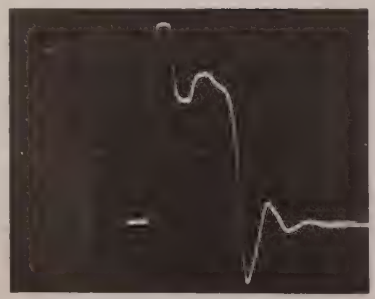

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Fig. 10 Adjusting R3

3. Adjusting R15 and R43

- Set the pulse generator PM 5711 for a PRT of 1 ms and for a display amplitude of four divisions
- Set the oscilloscope as follows:

a. Vertical	Volts/div	0.05
	Coupling	DC
b. Time base	Time/div	0.2 ms
	Trigger	Auto, HF, +

- Connect the probe to the pulse generator using the 50 Ω termination and the probe adaptor
- Adjust potentiometer R15 in order to obtain the correct display shown in Fig. 11
- Adjust potentiometer R43 in order to obtain the correct display shown in Fig. 12
- Readjust potentiometer R15 in order to obtain the correct display shown in Fig. 13

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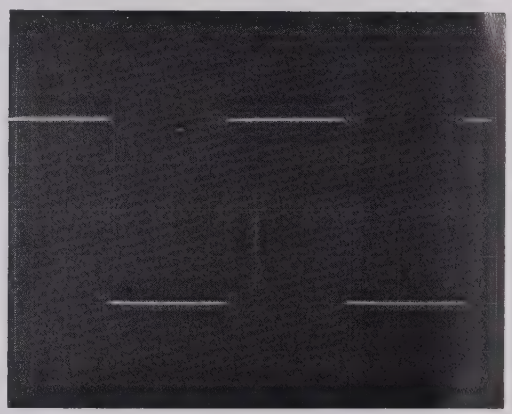

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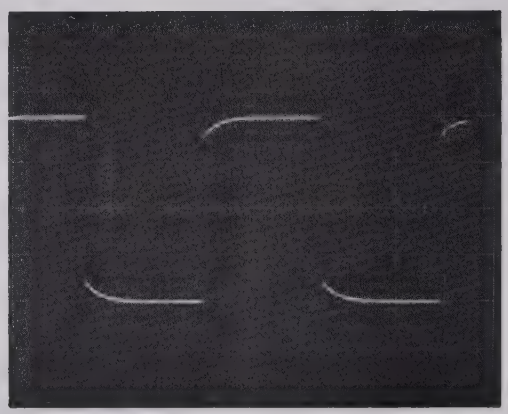

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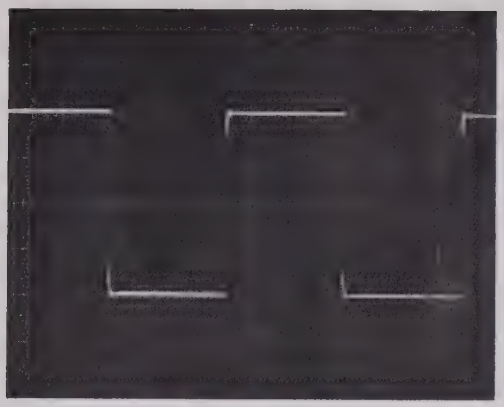
Fig. 11 Initial adjustment of R15



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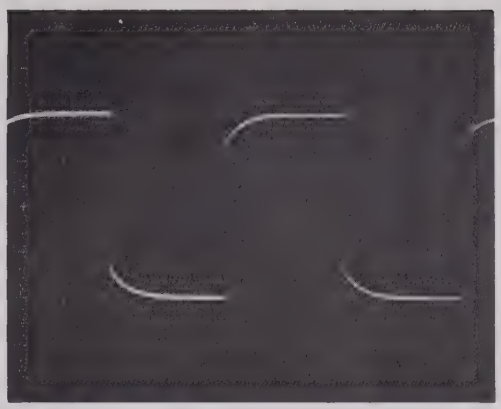

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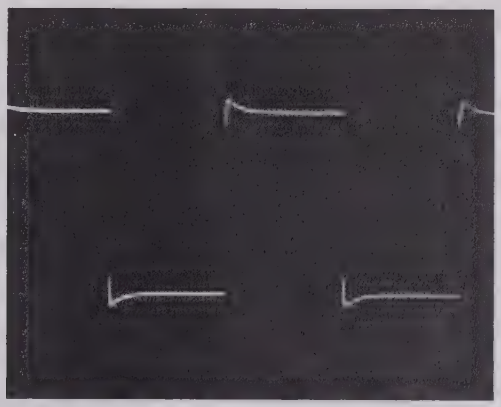

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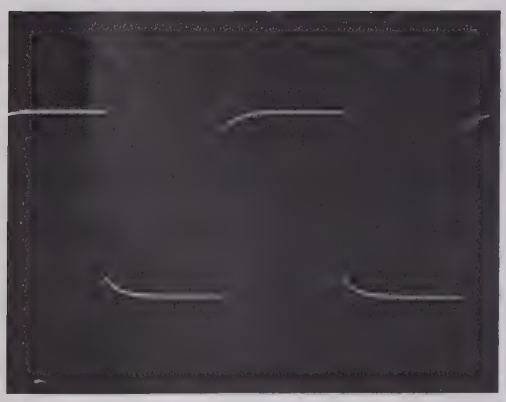
Fig. 12 Adjusting R43



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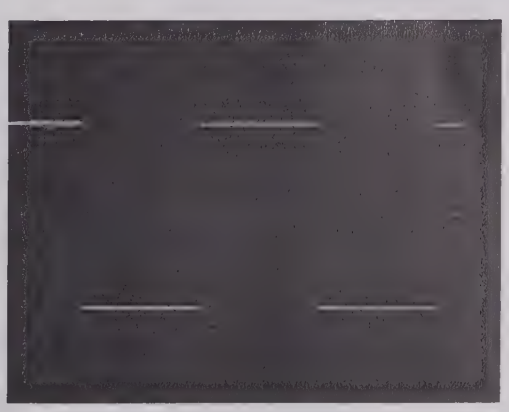

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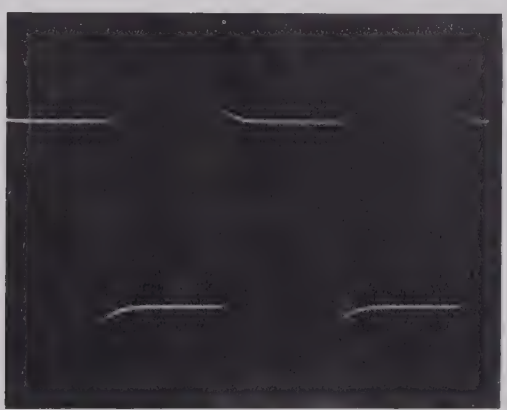

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Fig. 13 Final adjustment of R15

4. Adjusting C12

- Set the pulse generator PM 5711 for a pulse repetition time of 10 μs and for a display amplitude of 4 divisions
- Set the oscilloscope as follows:

a. Vertical	Volts/div	0.05
	Coupling	DC
b. Time base	Time/div	2 μs
	Trigger	Auto, HF, +

- Adjust C12 in order to obtain a correct display as shown in Fig. 14.
- Disconnect the pulse generator

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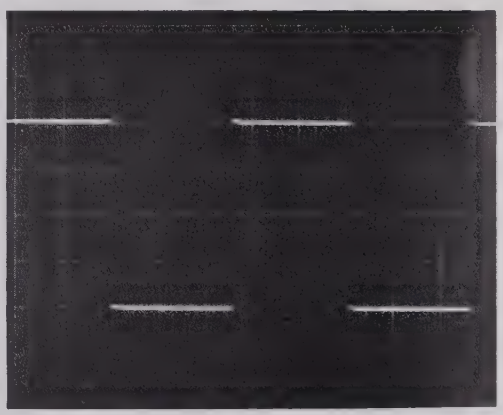

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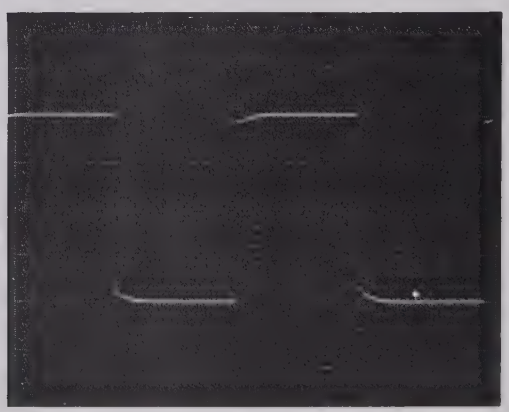

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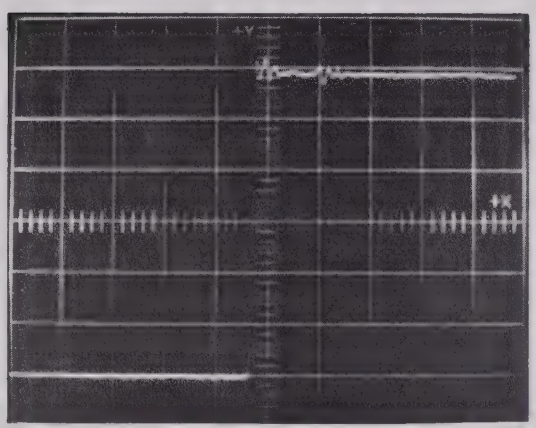
Fig. 14 Adjusting C12

E. HF Adjustments

- Set the fast pulse generator for a pulse repetition frequency of 10 kHz and 1 MHz and for a display amplitude of six divisions
- Set the oscilloscope as follows:

a. Vertical	Volts/div	0.05
	Coupling	DC
b. Time base	Time/div	0.05 μs
	Trigger	Auto, HF, +

- Connect the pulse generator to the probe using the 50 Ω termination and the probe adaptor
- Adjust R14 for a correct display as shown in Fig. 15. At the conclusion of the adjustments, disconnect the equipment and refit the compensating box cover.



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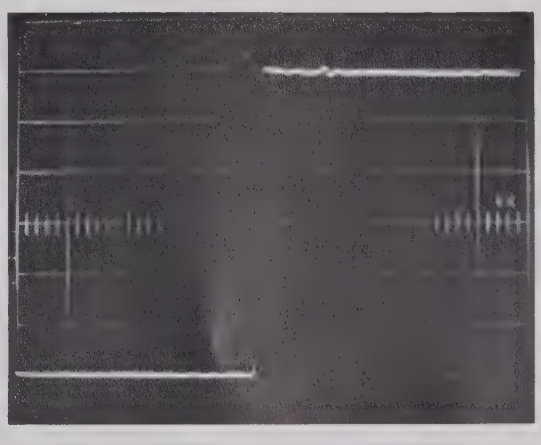

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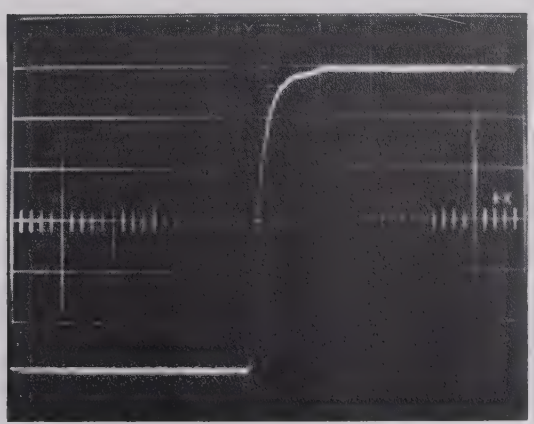

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Fig. 15 Adjusting R14

F. Rise time performance check

The rise time of the probe is measured by means of pulses having an amplitude of 2 V and a rise time of approximately 1 ns. The overall measured rise time is given by the following expression:

$$t_r = \sqrt{t_r^2 \text{ oscilloscope} + t_r^2 \text{ pulse} + t_r^2 \text{ probe}}$$

The time rise of the probe can be derived from this formula.

G. Displayed noise performance checks

- Connect the equipment as shown in Fig. 16, with the pulse generator set for a pulse repetition time of 0.3 ms at an approximate amplitude of 1.2 V, and the attenuator at 40 dB
- Set the oscilloscope as follows:

a. Vertical	m Volts/div	1.0
b. Time base	Time/div	20 μs
	Trigger	Free run, HF

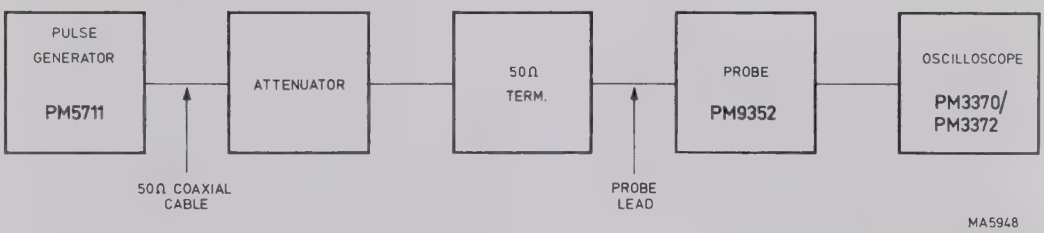

Fig. 16 Schematic diagram of equipment for displayed noise check

- Reduce the output voltage of the pulse generator until the dark band between the two noise bands just disappears
- When the two noise bands are just touching, the square wave voltage present at the probe tip is equal to the noise voltage, and is therefore ten times the magnitude of the noise voltage present at the output of the probe
- Set the attenuator to zero and reduce the oscilloscope sensitivity (e.g. to 10 or 20 mV/div) in order to measure the square wave voltage at the output of the probe. The output square wave voltage will now be 40 dB (100x) greater than the true value of the noise voltage at the probe output. Note that the probe output noise voltage will be 20 dB (10x) smaller than the equivalent noise voltage at the tip.

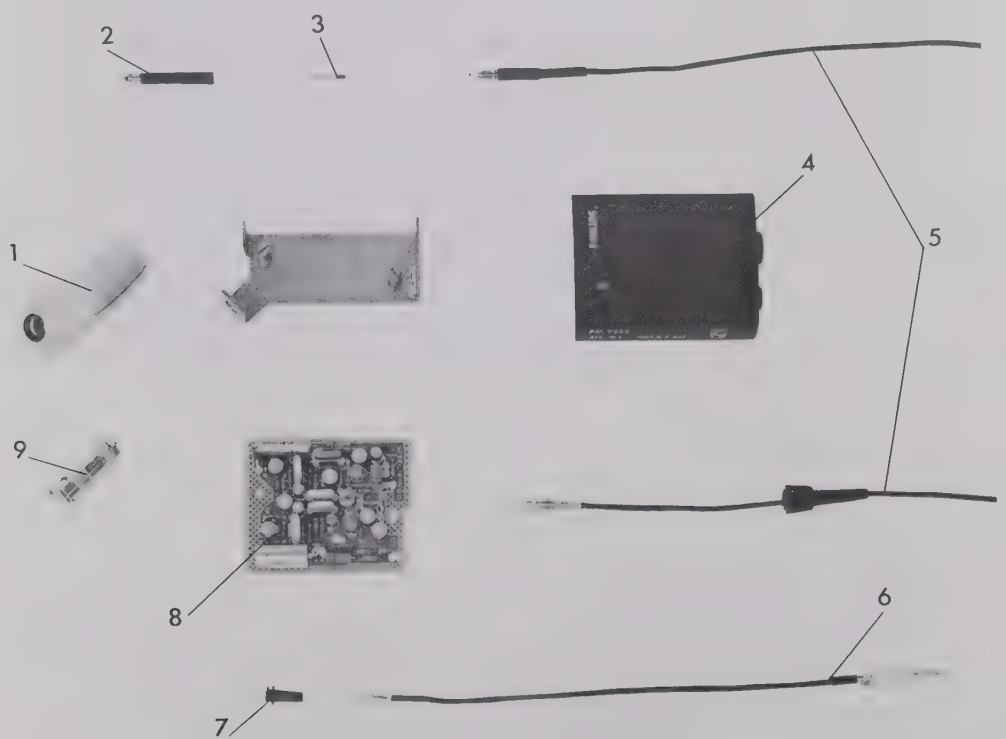

Fig. 17 Mechanical parts

X. PARTS LIST

A. Mechanical parts

Item	Fig.	Code number	Description
1	17	4822 447 60041	Compensating box top
2	17	4822 264 20031	Probe tip shell
3	17	4822 218 60088	Probe RC assembly
4	17	4822 447 60039	Compensating box cover
5	17	4822 320 10056	Probe lead assy.
6	17	4822 321 20248	Supply lead assy.
7	17	4822 325 50097	Grommet
8	17	4822 216 50196	Amplifier circuit board
9	17	4822 264 10043	BNC connector
10	18	4822 264 20032	Probe tip accessory for wrapped wiring systems
11	18	4822 264 20033	Probe tip accessory for dual in-line circuits
12	18	4822 264 20035	Probe test hook assembly
13	18	4822 462 70761	Probe earthing ring insulating tube accessory
14	18	4822 268 20055	Miniature connector accessory
15	18	4822 263 50053	Probe adaptor for BNC and N-connector
16	18	4822 264 20034	Earth tip accessory
17	18	4822 268 20056	Miniature right angle connector
18	18	4822 321 20237	Earth lead (15 cm) accessory for wrapped wiring systems
19	18	4822 321 20238	Earth lead (30 cm) accessory for wrapped wiring systems
20	18	4822 321 20239	Normal earth accessory (15 cm)
21	-	4822 600 30005	Carrying case including cable reel

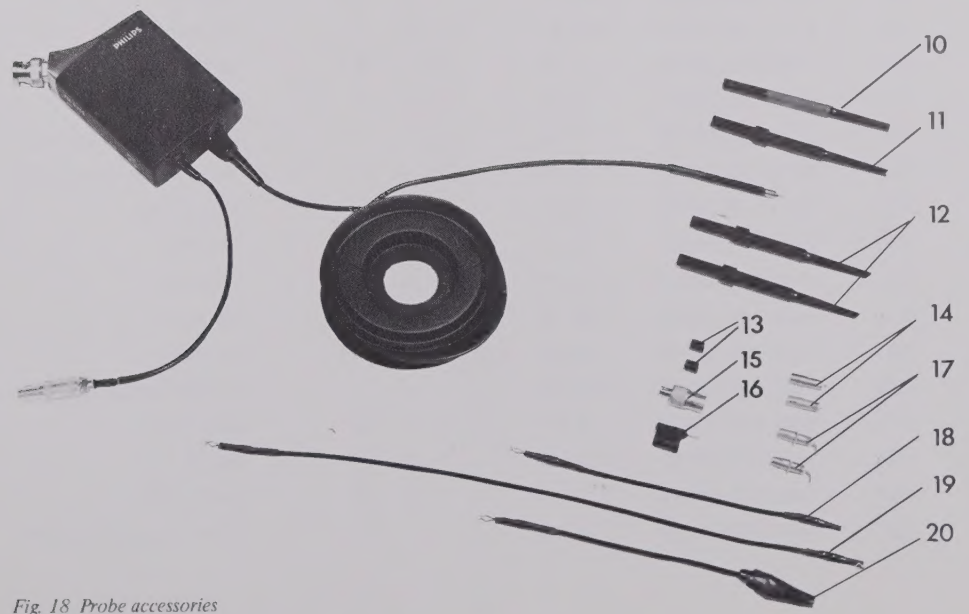

Fig. 18 Probe accessories

B. Capacitors

Item	Code number	Value	%	Volts	Description
C2	4822 122 30033	4.7 pF	-	63	Plate ceramic
C3	4822 122 30004	5.6 pF	-	63	Plate
C4	4822 121 40055	47 kpF	10	250	Plate
C5	4822 122 30028	56 pF	2	63	Plate
C6	4822 121 40055	47 kpF	10	250	Plate
C7	4822 121 40055	47 kpF	10	250	Plate
C8	4822 121 40055	47 kpF	10	250	Plate
C9	4822 121 30023	68 pF	2	63	Plate ceramic
C11	4822 122 30003	2.7 pF	-	63	Plate ceramic
C12	4822 125 50051	18 pF	-	-	Trimmer
C13	4822 122 30027	1 kpF	10	40	Plate ceramic
C14	4822 122 30043	10 kpF	-	40	Plate ceramic
C16	4822 122 30043	10 kpF	-	40	Plate ceramic
C17	4822 121 40047	10 kpF	-	250	Plate ceramic
C18	4822 124 10108	47 μF	-	35	Tantalum electrolytic
C19	4822 121 30043	10 kpF	-	40	Plate ceramic
C21	4822 124 10108	47 μF	-	35	Tantalum electrolytic
C22	4822 122 30043	10 kpF	-	40	Plate ceramic

C. Resistors

Item	Code number	Value	%	Wattage	Description
R2	4822 111 30365	51 Ω	5	0.1	Carbon
R3	4822 100 10138	100 Ω	-	-	Preset potentiometer
R4	4822 116 50762	5.11 kΩ	1	$\frac{1}{4}$	Metal film
R5	4822 111 30359	1.3 kΩ	5	0.1	Carbon
R6	4822 116 50762	5.11 kΩ	1	$\frac{1}{4}$	Metal film
R7	4822 116 50257	1.96 kΩ	1	$\frac{1}{4}$	Metal film
R8	4822 116 50257	1.96 kΩ	1	$\frac{1}{4}$	Metal film
R9	4822 110 30324	100 Ω	5	0.1	Carbon
R11	4822 110 30324	100 Ω	5	0.1	Carbon
R12	4822 116 50573	1 kΩ	1	$\frac{1}{4}$	Metal film
R13	4822 116 50573	1 kΩ	1	$\frac{1}{4}$	Metal film
R14	4822 100 10143	1 kΩ	-	-	Preset potentiometer
R15	4822 100 10141	10 kΩ	-	-	Preset potentiometer
R16	4822 116 50748	10 kΩ	1	$\frac{1}{4}$	Metal film
R17	4822 111 30364	20 kΩ	5	0.1	Carbon
R18	4822 111 30297	2 kΩ	5	0.1	Carbon
R19	4822 111 30366	75 Ω	5	0.1	Carbon
R21	4822 111 30306	75 kΩ	5	0.1	Carbon
R22	4822 100 10142	100 kΩ	-	-	Preset potentiometer
R23	4822 116 50748	10 kΩ	1	$\frac{1}{4}$	Metal film
R24	4822 116 50791	3.83 kΩ	1	$\frac{1}{4}$	Metal film
R26	4822 116 50945	7.15 kΩ	1	$\frac{1}{4}$	Metal film
R27	4822 100 10139	5 kΩ	-	-	Preset potentiometer

Item	Code number	Value	%	Wattage	Description
R28	4822 116 50608	6.19 kΩ	1	$\frac{1}{4}$	Metal film
R29	4822 116 50559	27.4 kΩ	-	$\frac{1}{4}$	Metal film
R31	4822 111 30324	100 Ω	5	0.1	Carbon
R32	4822 116 50581	2.49 kΩ	1	$\frac{1}{4}$	Metal film
R33	4822 116 50152	8.25 kΩ	1	$\frac{1}{4}$	Metal film
R34	4822 116 50608	6.19 kΩ	1	$\frac{1}{4}$	Metal film
R36	4822 100 10141	10 kΩ	-	-	Preset potentiometer
R37	4822 111 30364	20 kΩ	5	0.1	Carbon
R38	4822 116 50537	9.09 kΩ	1	$\frac{1}{4}$	Metal film
R39	4822 116 50762	5.11 kΩ	1	$\frac{1}{4}$	Metal film
R40	4822 116 50598	13.3 kΩ	1	$\frac{1}{4}$	Metal film
R41	4822 111 30324	100 Ω	5	0.1	Carbon
R42	4822 111 30364	20 kΩ	5	0.1	Carbon
R43	4822 100 10143	1 kΩ	-	-	Preset potentiometer

D. Transistors

Item	Code number	Type
TS1	4822 130 40205	BSX29
TS2	4822 130 40493	BFY90
TS3	4822 130 40353	BC179
TS4	4822 130 40353	BC179
TS6-1 TS6-2 }	4822 130 40709	BFS21A
TS8	4822 130 40144	BC109

E. Inductors

Item	Code number	
L1	4822 158 10278	1 mH
L2	4822 158 10278	1 mH

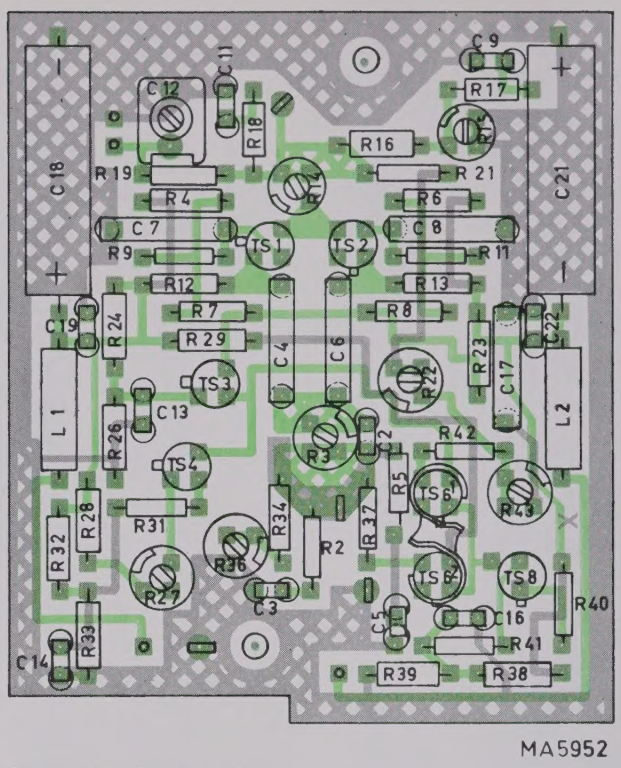

Fig. 19 Circuit board assembly

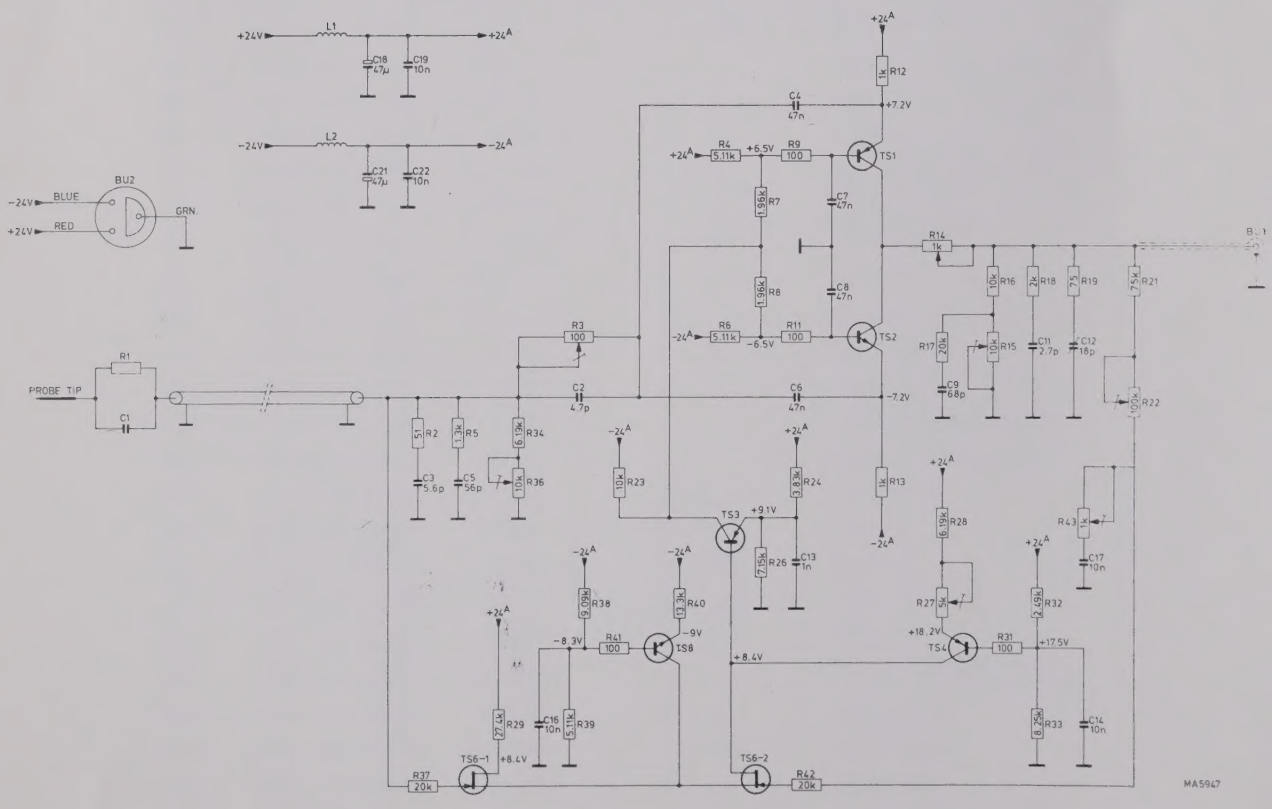

Fig. 20 Circuit diagram of PM 9352